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(पहला पुनरिक्षण *)*

Disaster Management in Drinking Water Utility — Requirements

(First Revision)

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Drinking Water Supply, Wastewater and Stormwater Systems and Services Sectional Committee had been approved by the Service Sector Division Council.

Water is a basic need to maintain the health and development of any community, inconsistency in the quantity and quality of water supply may produce devastating situations. Therefore, water utilities must maintain water supply systems that qualitatively and quantitatively meet the regulatory requirements to ensure minimal interruptions in the supply of drinking water. Given the impact of disasters on water supply systems such as the rupture and dislocation of mains and distribution pipes, contamination of water sources or damage to treatment facilities, mitigation and prevention are very important.

Disasters may occur by natural or manmade phenomena. To control or minimize its risk, it is essential to know the characteristics of the disaster and its impact on water utility. The approach of a water utility when preparing for any disaster should encompass all pertinent aspects of the water supply. The water utility needs to co-operate with all relevant authorities concerned with the disaster. Efficient disaster management should ensure that the actions taken before, during, and after the disaster should consider the natural environment as well as the impact on the health and well-being of the population. Effective communications with the public are necessary to establish trust in the water utility by disclosing important information appropriately in the area affected by a disaster or in neighboring areas.

This standard deals with the preparation, response, and recovery of drinking water supply systems from any natural or manmade disasters. It enumerates the steps that should be taken in preparing the water utility for a disaster situation (pre-disaster phase). It then provides requirements on how a disaster should be dealt with (the disaster phase). Guidelines on reestablishing services (post-disaster phase) and on drawing conclusions and revising procedures for future events follow.

While preparing this Indian Standard, assistance has been taken from ISO 24518 : 2015 on ‘Activities relating to drinking water and wastewater services — Crisis management of water utilities’.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

Indian Standard

DISASTER MANAGEMENT IN DRINKING WATER UTILITY — REQUIREMENTS

(First Revision)

1 SCOPE

This standard specifies the requirements for disaster management in drinking water utilities of all sizes to prepare, respond, and recover from any natural or manmade disasters.

NOTE — Disaster management in drinking water utility may vary depending on the specific circumstances and the scale of the disaster.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards:

IS No.	*Title*
IS 10500 : 2012	Drinking water — Specifications (*second revision*)
IS 17482 : 2020	Drinking water supply management system — Requirements for piped drinking water supply service
IS 18182 : 2023	Management of assets of drinking water supply system — Guidelines
IS 18188 : 2023	Service activities relating to drinking water supply, wastewater and stormwater systems — Vocabulary
IS/ISO 45001 : 2018	Occupational health and safety management systems — Requirements with guidance for use

3 TERMINOLOGY

For the purpose of this standard, in addition to the definitions given in IS 18188, the following shall apply.

3.1 Alternate Drinking Water Supply (ADWS) — Drinking water provided to users by means other than through the normal piped drinking water system.

3.2 Disaster — A sudden or unexpected or calamitous event or a natural catastrophe that causes huge or massive losses to a community or society or human or property or material or economic or environment.

NOTE — Disaster can be natural or anthropogenic.

3.3 Disaster Management — A continuous and integrated process of planning, organizing, coordinating and implementing measures that are necessary or expedient for the prevention of danger or threat of any disaster; mitigation or reduction of risk of any disaster or its severity or consequences; capacity-building; preparedness to deal with any disaster; prompt response to any threatening disaster situation or disaster; assessing the severity or magnitude of effects of any disaster; evacuation, rescue and relief; rehabilitation and reconstruction.

3.4 Drinking Water Supply System — System providing the functions of abstracting, transporting, treating, storing, distributing and supplying drinking water to end users.

3.5 Drinking Water Utility — Whole set of a society or a body or an organization dealing with drinking water and has processes, activities, means and resources necessary for abstracting, transporting, treating, distributing the drinking water and providing the associated services including risk and disaster management.

NOTES

1 Some key features of a drinking water utility are as follows:

- a) its mission, to provide drinking water services;
- b) its physical area of responsibility and the population within this area;
- c) its responsible body;
- d) the general organization with the function of operator being carried out by the responsible body, or by legally distinct operators; and
- e) the type of physical systems used to provide the services, with various degrees of centralization.

2 The term drinking water utility addresses a utility dealing only with drinking water.

3.6 Emergency Operation Plan (EOP) — Document specifying which procedures and associated resources should be applied by whom and where to a particular type of disaster.

3.7 Interested Party/Stakeholder — A person or a group or a society or an organization having an interest and concern and is involved in the services or performance of the drinking water utility.

NOTE — Consumers, building owners, relevant authorities, responsible bodies, external product and/or service suppliers, contractors, communities, environmental associations, financial institutions, scientific and technical organizations, laboratories are some examples of interested parties/stakeholders.

3.8 External Organization — Organizations working outside the scope of disaster management in the drinking water utility, although the outsourced function or process is within the scope.

NOTE — The concept of external organization includes, but is not limited to, sole trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private.

3.9 Outsource — An arrangement where an external organization performs part of the drinking water utility function or process.

3.10 Relevant Authority — Public body at National, Regional, or Local levels empowered to set general acts, or rules, or policies, or plans or guidelines or requirements, or to check compliance with these rules, to assist in response plan of drinking water utilities that are located under their area of jurisdiction.

3.11 Recovery Plan — Provision of policies, procedures and processes that are necessary to restore operations critical to the resumption of service.

NOTE — Recovery represents the last stage to be carried out during the disaster phase and the post-disaster phase prior to the changeover to routine operations.

3.12 Safety Audit — A systematic, objective, documented and independent evaluation to determine whether the activities conform to the requirements of the safety systems and procedures.

3.13 Supervisory Control and Data Acquisition (SCADA) — System operating with coded signals over communication channels in order to provide control of equipment and to acquire information about the status of the equipment for display or recording functions.

4 DISASTER MANAGEMENT IN DRINKING WATER UTILITY

4.1 Principles of Disaster Management

The drinking water utility shall consider the following principles in its disaster management:

a) Respecting the primacy of human life and human dignity through social, cultural, and gender neutrality and impartiality;
b) Risk management approach;
c) Sharing of relevant information and perspective;
d) Emphasizes the importance of safety for both responders and those impacted;
e) Flexibility (adaptability, scalability, and subsidiarity) of the system; and
f) Emphasize continual improvement to enhance performance.

4.2 General Requirements

The drinking water utility shall:

a) determine external and internal issues that are relevant to its purpose and its strategic direction and that affect its ability to achieve the intended outcome(s) of its disaster management;
b) identify relevant interested parties and their requirements and feedback of these interested parties;
c) identify natural and manmade disasters that could have an impact on general services provided by the utility, including those that the drinking water utility has not yet experienced;
d) develop comprehensive emergency operation plans for all phases of disaster including pre disaster, onset disaster and post disaster phases;
e) establish robust communication systems to disseminate emergency alerts, coordinate response efforts, and provide information to the public;
f) implement a robust water quality monitoring program to detect and address any potential contamination issues during disasters;
g) promote public awareness about emergency preparedness, safe water handling practices, and conservation measures; and
h) establish effective collaboration and coordination mechanisms with relevant stakeholders, including government agencies, emergency management organizations, NGOs, and community groups.

4.3 Determining the Scope of the Disaster Management

The drinking water utility shall determine the boundaries and applicability of disaster management to establish the scope. While determining the scope, the drinking water utility shall consider the following:

a) The principles referred in **4.1**; and
b) Requirements referred in **4.2**.

The scope of disaster management shall be available as documented information.

4.4 Records

To the extent necessary, the drinking water utility shall:

a) maintain documented information to support the operation of its processes;
b) retain documented information to have confidence that the processes are being carried out as per the planned schedule;
c) maintain the records of the workforce employed and needed, as per schedule; and
d) maintain records to establish traceability of processes causing major/minor non-conformity.

5 LEADERSHIP AND COMMITMENT

5.1 General

The top management shall demonstrate leadership and commitment with respect to the processes of disaster management while ensuring the following:

a) Scope and objectives of the disaster management are established and are compatible with the strategic direction of the drinking water utility;
b) Integration of the disaster management requirements into the core activities of drinking water utility;
c) Promoting the use of the process approach and risk-based thinking;
d) Resources needed for disaster management are available;
e) Communicating the importance of effective disaster management;
f) Activities of disaster management achieve their intended outcome(s);
g) Directing and supporting persons to contribute to the effectiveness of disaster management; and
h) Promoting continual improvement.

5.2 Policy

5.2.1 Top management shall establish a disaster management policy that:

a) is appropriate to the purpose of the drinking water utility;
b) provides a framework for setting disaster objectives;
c) includes a commitment to satisfy applicable requirements; and
d) includes a commitment to continual improvement of disaster management processes.

5.2.2 The disaster management policy shall be:

a) available as documented information;
b) communicated within the drinking water utility; and
c) available to interested parties, as appropriate.

5.2.3 The drinking water utility shall develop a policy for disaster management that includes the following:

a) Importance and place of disaster management within the overall strategy of the drinking water utility; and
b) Level of commitment of the top management to this issue.

5.3 Structural Organization for Responding to Disaster Situation

5.3.1 *General*

To enable quick planning, speedy acquisition of information and rapid response to a disaster, the drinking water utility shall establish an efficient and structured Disaster Management Team (DMT) and assign roles and responsibilities to the personnel involved in the team to ensure improvement in the performance of the following task:

a) Ascertaining and assessment of the situation;
b) Decision-making and implementation of decisions;
c) Monitoring and ensuring the implementation;
d) Documenting key decisions and recording actions taken;
e) Communicating internally and externally;
f) Continued supplying of adequate resources to deal with the disaster;
g) Providing alternate drinking water to its end users if required; and
h) Coordinating the event.

NOTES

1 The DMT may formulate sub-teams (operational employees of drinking water utility working in control rooms, laboratories, procurement and others) that carry out its orders.

2 Guidance on the structure of DMT is provided in Annex A.

The details of personnel involved in DMT shall be defined in advance at the planning stage. The details of the personnel with their contact number shall be published on the drinking water utility's official website, if any.

5.3.2 *Roles, Responsibilities and Authorities of Drinking Water Utility*

Top management shall ensure that the

responsibilities and authorities for relevant roles are assigned, communicated and understood within the drinking water utility to ensure the following:

a) Activities of disaster management conform to the requirements of this standard;
b) Processes are delivering their intended output(s);
c) Reporting on the performance of the disaster management and on opportunities for improvement in particular to top management;
d) Promotion of customer focus throughout the drinking water utility;
e) Plan of action is available in case of disaster (anthropogenic or natural); and
f) Necessary training of individuals involved in disaster management is provided.

6 PLANNING

6.1 Actions to Address Risks and Opportunities

6.1.1 When planning for disaster management, the drinking water utility shall consider the principles referred in **4.1** and the requirements referred in **4.2** and determine the risks and opportunities.

6.1.2 The drinking water utility shall plan:

a) actions to address these risks and opportunities;
b) how to:
    1) integrate and implement the actions into its processes of disaster management; and
    2) evaluate the effectiveness of these actions.

6.1.3 Disaster management processes shall enable the drinking water utility to manage a disaster in order to shorten its duration and mitigate its effects.

6.1.4 Risk assessment and its mitigation shall be included as part of pre disaster, onset disaster and post disaster phases.

6.1.5 The drinking water utility shall determine the thresholds that necessitate the activation of its emergency operation plan.

NOTE — Options to address risks can include preventive and corrective measures, eliminating the risk source, changing the likelihood or consequences.

6.2 Disaster Management Objectives

6.2.1 The drinking water utility shall establish objectives at relevant functions and levels in its disaster management with the following characteristics:

a) Consistency with the disaster management policy and requirement of this standard;
b) Measurable (if practicable);
c) Monitored;
d) Communicated; and
e) Updated, as appropriate.

The drinking water utility shall document information on disaster management objectives.

6.2.2 When planning how to achieve its disaster management objectives, the drinking water utility shall determine the following:

a) The present status;
b) Detailed actions on things to be done;
c) What resources will be required;
d) Who will be responsible;
e) How it will be done;
f) When it will be completed; and
g) Method of evaluation for results.

6.2.3 Objectives shall consider, as appropriate, the following but not limited to:

a) encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability;
b) efficient mechanism for identification, assessment and monitoring of risks;
c) security of the physical resources;
d) ensuring reconstruction as an opportunity to build disaster resilient structures to ensure safety;
e) prioritization of assets and operations for restoration of service taking the criticality of the service or users into consideration;
f) establishing intermediate restoration objectives and conditions to be achieved;
h) establishing a target timescale for the restoration of utility service, while considering levels of service to be achieved during the phases of disaster;
j) establishing thresholds at which point pre-determined actions will commence or terminate;
k) timely internal and external communication;
m) deciding on the amount and the timescale for the provision of ADWS to the disaster affected areas;
n) deciding on the type of ADWS such as bottled water, water tankers and the timescale for their provision; and
p) provisions of support to special categories of end users like hospitals, evacuation shelters, homes for the elderly, government and military establishments, and persons with special needs.

6.3 Risk Identification and Vulnerability Analysis

6.3.1 *Risk Identification*

The drinking water utility shall identify risks that affect its objectives. The techniques being used to identify the risks shall be relevant, appropriate and up-to-date.

The following factors, but not limited to, shall be considered during the identification of risks:

a) Sources (tangible or intangible);
b) Causes and events;
c) Threats and opportunities;
d) Vulnerabilities and capabilities;
e) Changes in the external and internal context;
f) Indicators of emerging risks;
g) Nature and value of assets and resources;
h) Consequences and their impact on objectives;
j) Limitations of knowledge and reliability of information; and
k) Time-related factors.

NOTES

1 The organization should identify risks, and whether their sources are under its control.

2 There may be more than one type of outcome, which may result in a variety of tangible or intangible consequences.

3 For the identification of natural hazards associated with a particular geographical region, the drinking water utility may refer to different hazard maps laid by National Disaster Management Authority or Indian Meteorological Department.

4 Drinking water utility should be aware of incidents that may trigger a disaster.

5 The list of examples of risks associated with drinking water supply systems and their impact is given in Annex B.

6.3.2 *Vulnerability Analysis*

The drinking water utility shall analyze potential threats to the drinking water supply system in its vulnerability analysis under the following categories:

a) Physical vulnerability;
b) Operational vulnerability; and
c) Organizational vulnerability.

6.3.2.1 *Physical Vulnerability*

The drinking water utility shall estimate the possible damage to infrastructure components as well as the area that would impact the operations of the drinking water supply system for every associated risk.

*Example*s: For the ease in the analysis, the following priorities can be selected in the drinking water supply system:

a) Priority 1 (High): More than 50 percent of components affected;
b) Priority 2 (Medium): Between 25 percent and 50 percent of components affected; and
c) Priority 3 (Low): Less than 25 percent of components affected.

NOTES

1 Having a well developed asset management plan enables drinking water utilities to optimize resource allocation, enhance infrastructure reliability, and deliver high-quality services to consumers. It also ensures strategic management and maintenance of the physical assets in its physical vulnerability analysis.

2 For the preparation of the asset management plan, guidance may be taken from IS 18182.

3 The components identified under physical vulnerability analysis should preferably be indicated in the direction of flow of water and must be classified in the following manner: intakes (different types) and their structures, main pipelines, treatment plants, pump stations, storage tanks, and distribution system.

4 Functional description of the system (flow volume, level, pressure, quality of the service) should be provided in the physical vulnerability analysis.

5 Simulate possible events and analyze the expected consequences to the system. These estimates should also include the population, institutions, and environmental elements potentially affected.

6.3.2.2 *Operational vulnerability*

To determine operational vulnerability, the top management shall:

a) identify the system's operational aspects such as capacity, demand, deficit or surplus volume;
b) quantify the capacity of each component and subsystem to operate in certain conditions, bearing in mind quantity, quality, and continuity to be maintained;
c) identify the critical assets and infrastructure of the drinking water supply system that may affect the drinking water supply system; and
d) identify measures to protect these critical assets and infrastructure.

6.3.2.3 *Organizational vulnerability*

The drinking water utility shall determine the response capacity of the drinking water utility, considering the available resources.

NOTE — In some cases, it may prove necessary to consider the cultural and socioeconomic characteristics of the community that benefits from the drinking water supply.

6.3.3 The drinking water utility shall document information collected in its risk identification and vulnerability analysis including the following details but not limited to:

a) GIS based geographical location and hydro-meteorological information of the drinking water utility;
b) GIS based 2-D line diagram of the assets of the drinking water supply system including the location of each asset;

c) Base map of area served by the drinking water utility showing key assets such as pipelines, valves, pumps and others;
d) Type of area served by the drinking water utility (domestic, industrial, institutional) and estimated water demand of that particular area;
e) Methodology adopted to prepare the vulnerability maps;
f) History of any disaster that occurred and its impact on drinking water utility;
g) Determine the vulnerability index (low, moderate, high, very high and sever); and
h) Challenges and areas of improvement.

NOTE — Organizational Vulnerability Index should be determine based on following grounds, but not limited to;

a) Statistics provided on disaster incidents and the damage caused by them – the areas where the incidence of disasters happen repeatedly are the most sensitive areas;
b) Based on available resources – In areas/districts where the required resources are not available in adequate quantity with the department, the area belongs to the sensitive area in terms of disaster; and
c) Areas distant from the main route – Areas where there is no accessibility facility or where there is no road facility. Generally, such areas are more sensitive than those connected to road.

6.4 Emergency Operation Plan (EOP)

6.4.1 *General*

The drinking water utility shall consider the protection of health, safety and the environment as the purpose of the emergency planning specific to each probable disaster.

6.4.2 When defining the scope of the EOP, the drinking water utility shall consider the following:

a) Geographical situation and changes in the nature of disasters according to the same and the potential damage and its effects;
b) Risk and vulnerability analysis as a part of EOP;
c) Types of disaster to be addressed in the plan;
d) Types of disaster to be specifically excluded from the plan (for example, because they are addressed by other plans);
e) Responsibilities and limitations due to areas of jurisdiction; and
f) Scale of emergencies, line of action for evacuation or safety.

6.4.3 EOP shall be,

a) dynamic in nature;
b) clear, concise, and complete;
c) designed with the participation of relevant interested parties/stakeholders;
d) categorized as pre disaster, onset disaster and post disaster measures;
e) having criteria and methods (including monitoring, measurements and related performance indicators) needed to ensure the effective operation and control of these processes;
f) designing a series of activities that enable prompt response and proper execution;
g) available in both electronic and hard copy formats to all interested parties/stakeholders identified within the EOP;
h) specify functions of each person or group involved in emergency operations based on the existing resources;
j) updated whenever there is a change in resources, personnel training, or the vulnerability of the system;
k) prioritizing the activities to be carried out with specific timeframe for completion;
m) widely disseminated and known by the staff; and
n) incorporating the local culture of the region.

NOTES

1 The EOP may be prepared as a stand-alone plan or as an annexure to another EOP.

2 Even if the EOP is stand alone, it could be integrated with the other EOP(s) if the plans are activated concurrently.

6.4.4 *Elements of EOP for Pre Disaster Phase*

The following elements, but not limited to, shall be created as part of the routine operation of the drinking water utility:

a) Promoting prevention, preparedness and mitigation at all levels through knowledge, innovation and education;
b) Procedures for assessing the risk to public health and the environment and determining risk control measures and risk communications;
c) Means of maintaining personnel safety including risk assessment, evacuation and shelter planning, off-site protective actions, first aid and emergency medical treatment;
d) Identification of sensitive areas based on vulnerability analysis;
e) Assessment of both the likelihood and its potential impacts on the drinking water supply system;
f) Systems, processes and procedures to monitor the parameters that enable the recognition of the beginning of a disaster as early as possible;
g) Processes and procedures to be assigned to DMT(s);
h) Infrastructure strengthening by ensuring,
    1) preparation of guidelines for the protection of physical assets;

  2) periodic repair and cleaning of vulnerable assets of drinking water supply system;
  3) repair or rehabilitation of physical assets on priority basis depending on the sensitivity/vulnerability assessment;

j) Procedure to provide the ADWS, if needed, in the timescale required;

k) Ensuring that the quality of ADWS confirms to IS 10500;

m) Identification of temporary points of distribution (TPDs) for the provision of ADWS;

n) Identification of priority supply points (such as hospitals) and forecasting their water demand;

p) Need assessment and capacity building of staff and community by ensuring,

  1) adequate training to the concerned personnel involved in disaster management;
  2) training/orientations to carry out the duties indicated in the EOP;
  3) awareness drives at the community level;
  4) active participation in the Mock drills;
  5) awareness raising campaigns on water and sanitation management and health outcomes; and
  6) training of identified personnel on how to develop timely and effective communication skills to inform the public, partners, and stakeholders about recommendations;

q) Mutual aid arrangements between the drinking water utility and other utilities in the event of a disaster;

r) Cooperation with relevant external organizations and procedure to communicate;

s) Arrangements to ensure the availability of resources necessary to respond to the scale of the emergency anticipated by the drinking water utility;

t) Ensure that assets of drinking water supply system have reliable backup power sources, such as generators, to maintain operation during power outages;

u) Ensure backup for water sources available, such as wells, reservoirs, or alternative supply systems, to ensure a continuous water supply even if one source is affected by a disaster;

v) Provision for the precise and prompt situation ascertainment for the assessment of type and extent of physical damage;

w) Maintain an adequate inventory of treated water reserves in storage tanks or reservoirs to meet the increased demand during emergencies;

y) Ensure that the water treatment plants have sufficient capacity to handle increased demand during emergencies;

z) Mechanism to communicate and coordinate with nodal agencies (public or private) to receive early information/warning in case of disaster backed by responsive and failsafe communication with information technology support; and

aa) Mechanism to coordinate with the associate departments like District Disaster Management Agency, local urban bodies, Panchayati Raj Organizations, Health Department and local community.

NOTES

1 Fire stations, police stations, and other government agencies undertaking emergency response activities are not recommended as distribution sites.

2 It is recommended to install the distribution sites at minimum distance of 1 km from the shelter points.

3 List of nodal agencies providing early information/warning is provided in Annex C.

6.4.5 *Elements of EOP for On-disaster Phase*

The drinking water utility shall consider the following activities in its EOP during the disaster phase:

a) Mechanism for accurate, timely, false safe and comprehensive broadcasting of disaster warnings to potential communities to be affected by the disaster;

b) Consistent coordination with the relevant stakeholder so that the latest information is updated about the disaster;

c) Concerned officials at all levels of disaster management are followed-up so that they are ready to respond to the disaster situation;

d) Prompt and precise assessment of the following components of drinking water supply system:

  1) Contamination of the water source and damage of the raw-water intake;
  2) Damage to the civil structures, including raw-water intake, water treatment plant, pumping station, distribution network and others;

   3) Mechanical damage, loss of power supply, contamination due to flooding;
   4) Damage to both sewerage and water mains in the same locality, with local seepage into water pipes where the pressure is reduced; and
   5) Plumbing of domestic or public buildings, resulting in back siphonage;

e) Provision of ADWS for affected people by managing with the available resources, till drinking water supply system facilities become operational;
f) Provision for relief, and aid to the victims by adopting appropriate measures;
g) Provision for declaration of demonization and termination of the special task, and upon deactivation, the operation shifts to the post-disaster phase of evaluation; and
h) Assessment of the surplus or the remaining capacity to provide the required utility services, including an estimate of the time required to rehabilitate the systems.

Standing orders related to disaster and preparedness shall be reviewed on an annual basis and the reviewed standing order shall be circulated among all concerned stakeholders for information and compliance.

NOTES

1 With time, as mitigation measures are carried out and equipment is obtained for emergencies, the onset disaster measures should be modified.

2 When issuing warning, special attention should be given on the words used for warning. It should always be kept in mind that the language of warning is simple and that can be understood by a common man.

6.4.6 *Elements of EOP for Post Disaster Phase*

The drinking water utility shall prepare post-disaster plan while considering the following:

a) Establish criteria to select priority recovery points;
b) Provision of separate situation assessment to detect the damage in disaster affected areas, prioritize repairs, and restore service as quickly as possible;
c) Quality check of affected components of the drinking water supply system;
d) Disinfection of affected components of the drinking water supply system;
e) Prevention and mitigation measures when designing the new construction or retrofitting plans, so as to prevent reoccurrence and nonconformity in future;
f) Criteria for the deployment of the measures for recovery;
g) Implementation of the recovery plan such as repairing the damage, verification, and restoring the utility service;
h) Identify rehabilitation and reconstruction measures to restore the utility services to the normal situation; and
j) Set criteria for assessments during the recovery stage.

6.4 Planning of Changes

When the drinking water utility determines the need for changes in the disaster management processes, the changes shall be carried out in a planned manner. The drinking water utility shall consider the,

a) need for the change and the expected gain;
b) purpose of the changes and their potential consequences on the drinking water quality and related services;
c) integrity of the disaster management;
d) availability of resources; and
e) allocation or reallocation of responsibilities and authorities.

7 SUPPORT

7.1 Resource Management

7.1.1 *General*

The drinking water utility shall:

a) determine and provide the resources needed for the establishment, implementation, maintenance and continual improvement of disaster management;
b) prepare procedures to make sure that one or more communication path(s) remain continuously available together with the documents and tools that are indispensable for disaster management;
c) take all steps practical to ensure the availability of the necessary resources needed for managing a disaster according to the EOP within the timescales required;
d) determine, provide and maintain the infrastructure necessary for the operation of its processes and to achieve conformity with the requirements of this standard;
e) incorporate advances in information management, technological resources such as geographic information systems (GIS), supervisory control and data acquisition (SCADA) systems while dealing disaster management to have the best possible information available for effective decision-making; and

f) identify the authority for mobilizing and requisitioning resources.

NOTE — Infrastructure can include safety equipment, transportation, energy supply, emergency control room, advanced technologies (including hardware and software).

7.2 Competence

The drinking water utility shall:

a) determine the necessary competence of person(s) doing work under its control that affects the performance of the drinking water utility;
b) ensure that these persons are competent on the basis of appropriate education, training or experience;
c) take actions to acquire the necessary competence, where applicable, and evaluate the effectiveness of the actions taken; and
d) retain appropriate documented information as evidence of competence.

NOTE — Applicable actions may include the provision of training, mentoring, re-assignment of currently employed persons, or the hiring or contracting of competent persons.

7.3 Training and Exercises

The drinking water utility shall identify the type and frequency of the training and exercises to be provided to their relevant personnel.

The drinking water utility shall ensure that the training and exercise program considers the following:

a) The level of competency required of the personnel;
b) Consistency with the objectives of disaster management;
c) Predetermined outcome, tabletop exercises, simulations, and fully operational exercises;
d) Procedures for evaluating the competency to handle a disaster situation;
e) Communication channel as a part of training and exercise;
f) Realistic scenarios and risk assessments;
g) Carefully planned so that minimum risk of disruption to normal operational processes;
h) Clearly defined objectives and result in a post-exercise report that contains recommendations;
j) Emergency resources such as communication equipment, response equipment, and backup generators are tested during an exercise; and
k) Prevention and mitigation measures are familiarized.

NOTE — The report of the training and exercises conducted by the drinking water utility should be documented. This report may be used to improve disaster management arrangements, including the capability of the people involved in the exercise, in a timely manner.

7.4 Awareness

The officer and staff doing work under the drinking water utility’s control shall be aware of:

a) the disaster management policy;
b) their contribution to the effectiveness of disaster management, including the benefits of improved performance; and
c) the implications of not conforming with the requirements mentioned in this standard.

7.5 Operational Arrangement

The drinking water utility shall establish operational agreements, where appropriate, with relevant external organizations considering the following:

a) Role of each party for the type of incident identified;
b) coordination and inter-organizational communication arrangement;
c) procedures for the dissemination of public communication;
d) exchange of relevant information to improve the EOP; and
e) exchange of information regarding changes in the circumstances within the organization, that could influence the operation of the EOP.

The drinking water utility shall periodically evaluate the performance of disaster management to determine whether the objectives and benefits involving operational agreements are being met and use the results of these evaluations when making joint decisions about continual improvement.

NOTES

1 The drinking water utility may establish operational agreements with local, regional, national and international authorities concerning mutual assistance, governments on different levels to provide disaster management resources, private/non-governmental organizations for food, shelter, health services, relevant authorities for emergency power supply, transportation, communications, delivery of medications, vaccine, and private industries in order to ensure continuity of operations (delivery of relevant products).

2 Variety of channels and techniques such as mass media (radio, television, newspapers), megaphone vans, religious services, social media, or community message boards should be used to disseminate relevant information such as which locations will have access to the utility services, on what days and at what time.

7.6 Communication and Coordination

7.6.1 *General*

The drinking water utility shall determine the need for internal and external communications relevant to disaster management including:

a) person authorized to perform communication;
b) what to communicate;
c) when to communicate; and
d) how to communicate.

7.6.2 *Internal Communications and Coordination*

The drinking water utility shall communicate the following information to all those within the utility identified in initiating and implementing the EOP:

a) The role they are identified for;
b) The process and procedures they are required to follow;
c) The training and exercise that they are intended to perform in the execution of the plan; and
d) Any change to disaster management that is pertinent to their role.

NOTE — The drinking water utility should determine the frequency of such communications to ensure that its state of preparedness is maintained.

7.6.3 *External Communications and Coordination*

The drinking water utility shall ensure open communication with the external organization identified in its EOP. This shall aim to ensure compliance with the operational agreement as given in **7.5**.

In case of a disaster situation, details of the incident shall be communicated to all the relevant stakeholders.

The drinking water utility shall agree with all identified external organizations on the frequency, method and format of such communications.

7.7 Documented Information

7.7.1 The disaster management shall include,

a) documented information required by this Indian Standard; and
b) documented information determined by the drinking water utility as being necessary for the effectiveness of disaster management.

NOTE — The extent of documented information for disaster management can differ from one water utility to another due to:

a) the size of the water utility and its type of activities, processes, products and services;
b) the complexity of processes and their interactions; and
c) the competence of people.

7.7.2 All procedures for dealing with a disaster, nominations to the DMT, collaboration agreements with external organizations, lists of equipment and their location, special arrangements shall be documented to an extent that is accurate and complete but remains easy to understand. The documents, which may be either in electronic or paper format or both, shall be stored in a safe, but accessible place, including off site locations so that they can be retrieved quickly when the need arises.

When creating and updating documented information, the drinking water utility shall ensure the following:

a) Identification and description of the document (title, date, author, or reference number);
b) Format (language, software version, graphics) and media (paper, electronic); and
c) Review and approval for suitability and adequacy.

All decisions shall be recorded in writing, and the reason for each decision shall be documented.

In the event of a disaster, the alerting of the DMT as well as its work shall be documented for later reference.

Any changes (internal or external) that impact the drinking water utility shall be reviewed in relation to its disaster management. The review shall also identify any new critical activities that need to be included in the disaster management.

NOTE — This information should be updated in the incident briefing form as per Annex D.

7.7.3 Documented information required in disaster management shall be controlled to ensure,

a) it is available and suitable for use, where and when it is needed; and
b) it is adequately protected from loss of confidentiality, improper use, or loss of integrity.

7.7.4 Documented information of external origin determined by the drinking water utility to be necessary for the planning and operation of the disaster management shall be identified as appropriate, and controlled by considering the following:

a) Distribution, access (permission to view or permission and authority to view and make changes), retrieval and use;
b) Storage and preservation, including preservation of legibility;
c) Control of changes (version control); and
d) Retention and disposal.

The drinking water utility shall have at least one backup set of documented information stored offsite, but readily accessible.

8 OPERATION

8.1 Operational Planning and Control

8.1.1 The drinking water utility shall plan, implement and control the processes needed to meet requirements and implement the actions by:

a) establishing criteria for the processes;
b) implementing control of the processes in accordance with the criteria; and
c) documenting information to the extent necessary to have confidence that the processes have been carried out as planned.

8.1.2 The drinking water utility shall control planned changes and review the consequences of unintended changes, taking action to mitigate any adverse effects, as necessary.

8.1.3 The drinking water utility shall ensure that externally provided processes are controlled.

NOTE — The drinking water utility may refer to IS 17482 for further information on control of externally provided processes, products and services.

8.1.4 The drinking water utility shall ensure that key processes of external organizations outside its control, but upon which its own disaster management processes rely are monitored. This monitoring activity shall include both planned and unplanned changes which may affect the integrity of its own processes.

8.2 Response

8.2.1 *General*

When the criteria of the disaster situation are met, the drinking water utility shall:

a) activate the DMT;
b) activate links with other DMT at National, State, or Regional level and external organizations; and
c) transfer applicable authority to the DMT.

NOTE — It shall be recognized that knowledge and information can be incomplete and that the situation continues to evolve and change rapidly during this phase.

8.2.2 *Activating the DMT*

The procedures for convening the DMT shall be defined in advance at the planning stage (pre disaster phase) that determines whom to inform and in which manner.

The following steps shall be taken so that the DMT acts as soon as possible:

a) Decision for the DMT to convene, including the designation of the head of the DMT;
b) Check the availability of all the members of the DMT and ensure immediate replacement of any non-available member deemed essential.

8.2.3 *Establish and Activate Links with Other DMT(s)*

The head of DMT shall ensure,

a) establishment of links to appropriate external DMT(s);
b) activation of the links with other DMT(s) of relevant external organizations identified under the EOP;
c) activate communication channels;
d) availability of the necessary resources needed; and
e) activate communication with the nodal agencies handling the disaster.

8.2.4 *Alternate Drinking Water Supply through Atlernate Source*

The drinking water utility shall ensure the target levels of minimum per capita alternate drinking water supply of 2 litres for first 3 days, subsequently, 8 litres for next 5 days and further 10 litres for 21 days from the date of announcement of disaster.

NOTE — These figures can be suitably increased based on the availability of water sources and accessibility to the end users.

8.2.5 *Transfer of Decision Making Authority to the DMT*

The transfer of relevant decision-making authority following the convening of the DMT from normal corporate to organizational structures (from the head of top management to the head of the DMT) shall encompass:

a) any required adjustments to authority to make financial commitments;
b) transfer of locations and equipment; and
c) transfer of all relevant documents prepared during the preparedness phase.

8.2.6 *Workflow of the DMT*

Once the DMT team is activated, it shall undertake the following:

a) Situation ascertainment and situation assessment — The assessment of the situation results from the analyses, interpretation and integration of the findings of the situation ascertainment;
b) Decision making — The head of the DMT with the input of their team shall make decisions based on the resources and information available. All decisions shall become documented information;

c) Implementation of decisions and issuing of orders — The head of the DMT shall issue the necessary orders on the basis of the decisions taken;
d) Supervision and operational control — The head of the DMT shall supervise and control the execution of orders to ensure that orders are carried out properly; and
e) Communications and cooperation — The head of the DMT shall ensure that the communications plans are implemented to ensure effective communications within the DMT(s), with customers and the general public, external organizations, relevant stakeholders and within the drinking water utility.

The head of the DMT shall also ensure that the protocols agreed with the relevant authorities are enacted.

8.3 Recovery to Normal Operation

The DMT shall allocate operational team for the recovery to normal operation. The sequence of actions during the recovery stage shall be:

a) Recovery Plan — The DMT shall develop a priority recovery plan based on clear criteria for determining the order of priorities and deployment of the measures for recovery;
b) Implementation of the Recovery Plan — The DMT shall implement the recovery plan by repairing the damage, verification and restoring the service; and
c) Assessments During Recovery Stage — The DMT shall conduct a separate situation assessment, in order to evaluate the situation during the recovery stage.

NOTE — Refer Fig. 1 for schematic workflow of Disaster Management Team (DMT).

8.4 Termination of the Work of DMT

When clear and sufficient information for the resumption of normal operational management is available, deactivation of the DMT shall be declared by the top management.

Upon deactivation of the DMT, the operation shall shift to the post disaster phase of evaluation and review followed by consideration of continuous improvement actions.

NOTE — The drinking water utility may outsource responsibility related to collection of information, monitoring and measurement, risk assessment, intelligence and investigations or any other activity identified by the top management to other departments or organizations, if required.

9 PERFORMANCE EVALUATION

9.1 Monitoring, Measurement, Analysis and Evaluation

9.1.1 The drinking water utility shall determine the following:

a) What needs to be monitored and measured;
b) The methods for monitoring, measurement, analysis and evaluation, as applicable, to ensure valid results;
c) When the monitoring and measuring shall be performed;
d) When the results from monitoring and measurement shall be analyzed and evaluated.

The drinking water utility shall retain appropriate documented information as evidence of the results and evaluate the performance and effectiveness.

9.1.2 Monitoring of the disaster management shall include the effectiveness of the following:

a) Implementation of the disaster management in the drinking water utility;
b) Operation during a disaster;
c) Operation during an exercise.

9.1.3 *System Evaluation*

The drinking water utility shall evaluate the procedures, and capabilities through periodic reviews, testing, post disaster reports, lessons learned, performance evaluations, safety audits and exercises. The procedures shall be updated promptly to reflect significant changes due to these factors.

Consistent with its commitment to compliance, the drinking water utility shall establish, implement and maintain procedures for periodically evaluating compliance with applicable legal requirements and compare industry good practices and compliance with its own policy and objectives related to disaster management.

The drinking water utility shall keep records of the results of the periodic evaluations.

9.2 Safety Audit

9.2.1 *Objectives of Safety Audit*

The drinking water utility shall ensure that safety audits and assessments of processes of the disaster management are conducted at planned intervals to provide information on whether the disaster management,

a) conforms to:
    1) drinking water utility’s own requirements for its disaster management;

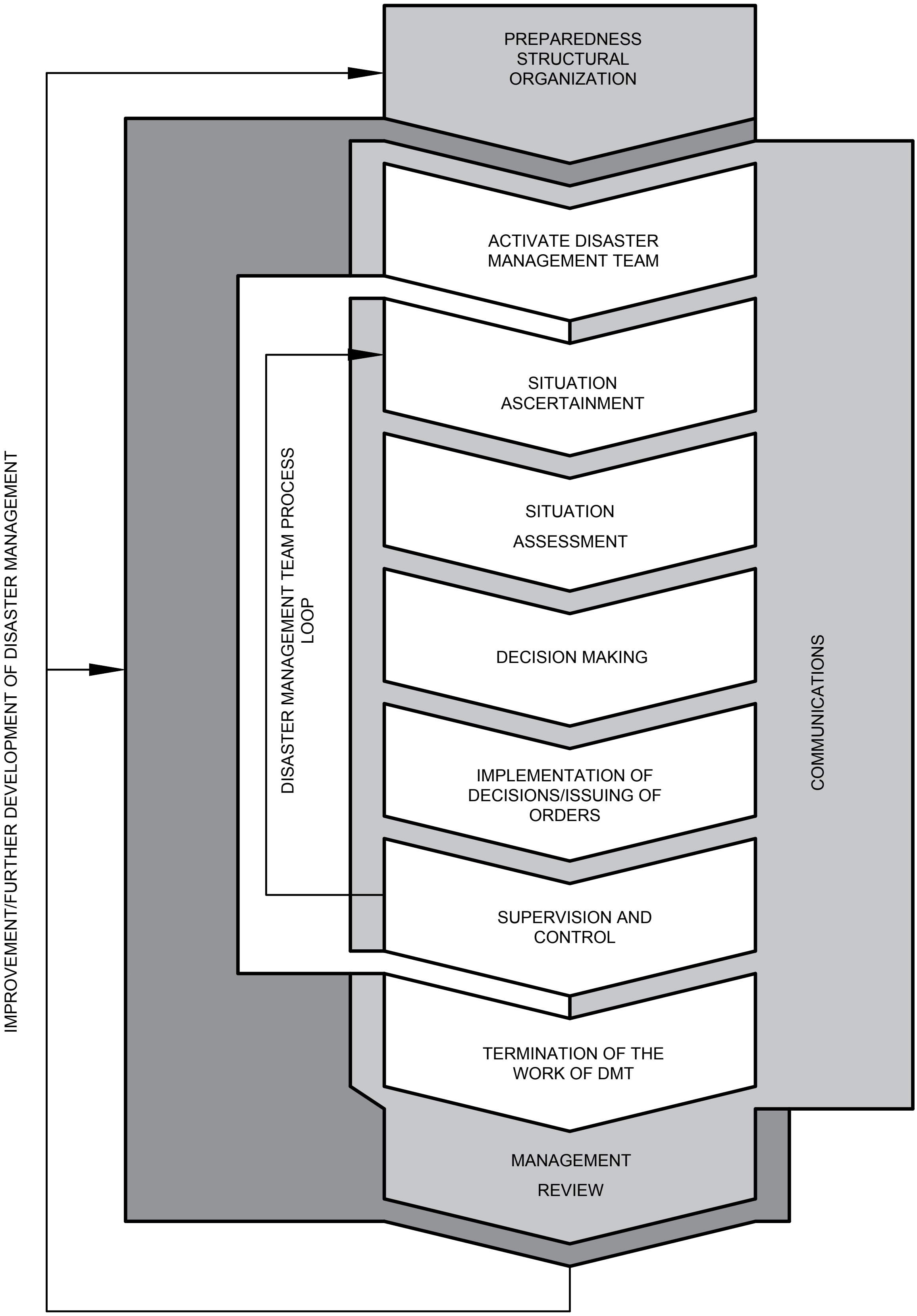
PREPAREDNESS STRUCTURAL ORGANIZATION
ACTIVATE DISASTER MANAGEMENT TEAM
SITUATION ASCERTAINMENT
SITUATION ASSESSMENT
DECISION MAKING
IMPLEMENTATION OF DECISIONS/ISSUING OF ORDERS
SUPERVISION AND CONTROL
TERMINATION OF THE WORK OF DMT
MANAGEMENT REVIEW
IMPROVEMENT/FURTHER DEVELOPMENT OF DISASTER MANAGEMENT
DISASTER MANAGEMENT TEAM PROCESS LOOP
COMMUNICATIONS

FIG. 1 SCHEMATIC WORKFLOW OF A DISASTER MANAGEMENT TEAM (DMT)

   2) requirements of this standard;
   3) all relevant specific arrangements; and
   4) is effectively implemented and maintained.

The drinking water utility shall establish procedures to,

a) plan, establish, implement and maintain safety audit or assessment program(s), including the frequency, methods, responsibilities, planning requirements and reporting.
b) the safety audit program(s) shall take into consideration the importance of the processes concerned, the resilience of operations concerned and the results of previous safety audits;
c) define the safety audit criteria and its scope;
d) select auditors and conduct safety audits to ensure objectivity and the impartiality of the safety audit process;
e) ensure that the results of the safety audits are reported to the top management; and
f) document information as evidence of the implementation of the safety audit program and the results.

Safety audit and assessment procedures shall be established, implemented and maintained that address responsibilities and requirements for planning and conducting audits, reporting results and retaining associated records, determination of safety audit criteria, scope, frequency and methods, and provide information on the results of audits to management.

Assessment shall be conducted against the drinking water utility's objectives.

9.2.2 *Methodology and Technique for Safety Audit*

The drinking water utility shall ensure that the following methodology and techniques is being applied in the drinking water utility during safety audit:

a) Overview on safety shall be taken scientifically, evaluating the level of safety practice under several parameters using standardized evaluation from IS/ISO 45001;
b) The drinking water utility shall forward a copy of the auditor's report along with his comments to the top management within 30 days after completion of such audit;
c) Periodically safety visit inspection at plant/installation shall be done by top management as and when required;
d) Safety register shall be signed by authorised person; and
e) Any delay in restoration shall be brought under the notice of top management.

9.3 Management Review

Top management shall review the disaster management, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness.

The management review shall include consideration of the following:

a) The status of actions from previous management reviews;
b) Changes in external and internal issues that are relevant to the disaster management;
c) Information on the performance, including trends in the following:
   1) Nonconformities and corrective actions;
   2) Monitoring and measurement results; and
   3) Audit results;
d) Opportunities for continual improvement.

The outputs of the management review shall include decisions related to continual improvement opportunities and any need for changes to the disaster management.

The drinking water utility shall document information as evidence of the results of management reviews.

10 IMPROVEMENT

10.1 Nonconformity and Corrective Action

10.1.1 When a nonconformity occurs, the drinking water utility shall react to the nonconformity, and take necessary actions to control and correct it. The drinking water utility shall evaluate the need for action to eliminate the causes of the nonconformity, in order that it does not recur or occur elsewhere by,

a) reviewing the nonconformity;
b) determining the causes of the nonconformity;
c) determining if similar nonconformities exist, or could potentially occur;
d) implement any action needed;
e) review the effectiveness of any corrective action taken; and
f) make amendments or adapt changes to the disaster management, if necessary.

10.1.2 Corrective activities shall be appropriate to the effects of the nonconformities encountered.

10.1.3 The drinking water utility shall document information as evidence of the nature of the nonconformities and/or any subsequent actions taken, and the results of any corrective action.

10.1.4 The drinking water utility shall establish, implement and maintain procedures for dealing with actual and potential shortfalls in the disaster management system and for taking improvement and corrective actions. The procedures shall define criteria for the following:

a) Identifying the shortfalls of the disaster management and taking actions to mitigate their impact and avoid their recurrence;

b) Evaluating the need for actions to improve the disaster management plan's shortfalls and implementing appropriate actions designed to avoid their occurrence to a specified timeline;

c) Recording the results of corrective actions and improvement actions taken; and

d) Reviewing the effectiveness of the corrective and improvement actions taken.

10.1.5 Actions taken shall be appropriate to the magnitude of the problems, risk and their potential impacts. The drinking water utility shall ensure that any necessary changes are made to disaster management documentation within a specified timeline.

10.2 Continual Improvement

The drinking water utility shall continually improve the suitability, adequacy and effectiveness of the disaster management.

The outputs from management reviews shall include any decisions and actions related to possible changes to the disaster management policy, objectives, targets and other elements of the disaster management, consistent with the commitment to continual improvement.

ANNEX A

(*Clause* 5.3.1)

STRUCTURE OF DISASTER MANAGEMENT TEAM (DMT)

A-1 The drinking water utility may include the following personnel in the DMT:

a) *Head of DMT* — Officer with authority and control of the incident/disaster, ordering and release of resources. The head should have the overall authority and responsibility for conducting incident operations and should be responsible for the management of tactical operations at the disaster site. The head can appoint sub teams which will work in accordance with the emergency operation plan.

b) *Public Relation Officer* — Responsible for interfacing with the public and media; coordination with external organizations, relevant authorities and other agencies during disaster; communicating with early warning system as a part of EOP with incident-related information requirements.

c) *Expert Advisor/Consultant* — Expert advisors/consultants should provide specific knowledge involved in the emergency response.

d) *Planning Team* — Collection, evaluation and timely sharing of incident information and intelligence; status reports including assigned resources and staffing; development and documentation of emergency operation plan; information gathering, sharing and documentation at each stage of disaster such as pre, post and onset of disaster.

e) *Safety Officer* — Conduct training and mock drills; hazard reduction; protection of people, property and environment; control of incident and transition to recovery phase.

f) *Operation Officer* — Timely storage of necessary material to meet the drinking water needs of disaster affected areas by ensuring availability of required assets such as specials tools and plants (T&P), spare parts of centrifugal pumping plant, hand pipe and submersible pump in the secured stock of the drinking water utility; incident support and resources; facilities, transportation, supplies, equipment maintenance, fuel, food service and medical services for incident personnel; communications and information technology support.

g) *Logistics Officer* — Ordering resources from off-incident locations; providing facilities, security (of any disaster management command facilities), transportation, supplies, equipment-maintenance and fuel, food services and emergency responder medical services, including inoculations, as required.

h) *Information and Communication Technology Support* — Provides secure IT-infrastructure, defines roles and rights for software applications, evaluates the system performances and plans fall back communication and IT structures.

ANNEX B

(*Clause* 6.3.1)

EXAMPLES OF RISK IN CONTINUOUS (24*7) DRINKING WATER SUPPLY SYSTEM AND THEIR ASSOCIATED IMPACT

Table 1 Types of Risk and Levels of Impact

(*Clause* 6.3.1)

Sl No. (1)	Type of Risk (2)	Low Impact (3)	High Impact (4)
i)	**Public Health**		
	a) Water Supply — Interruption	a) No water supply for less than 6 h to atleast 10 percent of end users, b) No water supply for 6 h to 12 h to at least 25 percent of end users.	a) No water supply for greater than 12 h to atleast 50 percent of end users, b) No water supply for greater than 12 h to 100 percent of end users.
	b) Water Supply — Contamination	a) Weak contamination to 25 percent of properties, can be cured by boiling, b) Moderate contamination (don't drink) to 25 percent of consumers.	a) Weak contamination to 50 percent of properties, can not be cured by boiling, b) Moderate contamination (don’t drink) to 50 percent of consumers.
	Water Supply — Severely discolored water	50 percent of consumers are affected	Greater than 50 percent of consumers are affected
ii)	**Environmental**		
	Flooding — Internal and/or external sewage flooding affecting a property	In a localized area	In a widespread area
	Flooding — Processing of deferred blockages	Over 100 percent of normal blockage levels for 1 to 3 regions deferred until the next day.	Over 100 percent of normal obstruction levels for more than three regions deferred until the next day.
	Watercourse pollution	a) Minor Fish kill, b) Short term widespread environmental damage, c) Significant visible gross pollution or littering of watercourse.	a) Major Fish kill, b) Long term widespread environmental damage, c) Extensive visible gross pollution or watercourse littering, d) Loss/closure of watercourse for amenity use.
	Chemical release to the environment	Significant breach — local procedures invoked — emergency services attend.	Major release beyond boundary potential evacuation/casualties

Table 1 (*Concluded*)

Sl No. (1)	Type of Risk (2)	Low Impact (3)	High Impact (4)
iii)	**Property**		
	Dams	Where remedial or preventative action is necessary to safeguard the structure.	Significant danger of dam failure necessitating major mobilization of resources. Urgent drawdown.
	Telemetry	Urgent Loss of several sites	Prolonged widespread failure.
	Facilities	Where remedial or preventative action is necessary to safeguard the structure. Urgent investigation	Significant danger of dam failure necessitating major mobilization of resources. Urgent drawdown.
iv)	**Reputation**		
	Public Interest/stakeholder impact	Significant existing or potential adverse media interest in a Local office issue.	Authority wide issues requiring a coordinated response.

ANNEX C

(*Clause* 6.4.4)

EARLY WARNING SYSTEM

C-1 The early warning system plays an important role in reducing the risks of any type of disaster. An organization that has a more active early warning system from the state to the district level has lesser risk in the context of the disaster. The early warning system shall work in both directions, from top to bottom and from bottom to top. That is, prior warnings or information received from the government are important for preparing the community for disaster relief and it is also necessary for the administration to take information from the community to plan locally.

C-2 NODAL AGENCY FOR EARLY INFORMATION/WARNING

Institutions authorized by the Government of India to give initial warning during the various disasters in respect of disasters at the department level are as follows:

Table 2 Institutions Authorized by the Government of India to Issue Early Warning for Different Disasters

(*Clause* 6.4.4)

Sl No. (1)	Disaster (2)	Authorized Institution (3)
i)	Flood	Central Water Commission
ii)	Heavy Rain/ Cloud Burst, Landslide	Geological Survey of India
iii)	Avalanche	Snow/Ice and Avalanche Study Establishment
iv)	Heat Wave and Cold Wave	Indian Meteorological Department
v)	Cyclones	Indian Meteorological Department
vi)	Tsunami	Indian Tsunami Early Warning Centre (ITEWC) Indian National Centre for Oceanic Information Services
vii)	Chemical Disaster	Ministry of Environment and Forest
viii)	Biological	Ministry of Health and Family Welfare
ix)	Nuclear/Radiological	Department of Atomic Energy

ANNEX D

(*Clause* 7.7.2)

INCIDENT BRIEFING FORM

D-1 The drinking water utility shall provide following information, but not limited to, in the incident briefing form:

- a) Brief of the incident including type of disaster (including fire, earthquake, landslide, flood, cyclone and other), date, time and source of first warning received by the drinking water utility, intensity of disaster (low, moderate, high, sever), duration of disaster, impact of drinking water utility, name and designation of officer and command;
- b) Site layout and affected areas with date and time of preparation;
- c) Details of following actions taken:
  - 1) Provision of ADWS;
  - 2) Provision of water supply at priority supply point such as hospital, fire stations, transit camps, relief camps;
  - 3) Status of physical assets including their unit ID;
  - 4) Status of power supply;
  - 5) Status of transportation services;
  - 6) Emergency arrangement for restoration and maintenance of drinking water supply system;
  - 7) Difficulty in any in response including mobilization of resources and manpower; and
  - 8) Other.
- d) Summary of the resource allocation including resource type, quantity, site of deployment and assignments;
- e) Threats, if any, which may be increase severity of incident; and
- f) List of tasks assigned with name of concerned officer.

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Drinking Water Supply, Wastewater and Stormwater Systems and Services Sectional Committee, SSD 14

Organization	*Representative(s)*
Military Engineer Services, New Delhi	Shri Suneel Kumar Arora **(*Chairperson*)**
Brihan Mumbai Municipal Corporation, Mumbai	Shri Anil Ragunath Kotkar Shri U. S. Mudras (*Alternate*)
Central Pollution Control Board, New Delhi	Shri Vishal Gandhi Shri Danish Meena (*Alternate*)
Central Public Health and Environmental Engineering Organization, New Delhi	Dr Ramakant
Central Public Works Department, New Delhi	Shri Divakar Agrawal Shri Chandra Shekhar Azad (*Alternate*)
Central Water Commission, New Delhi	Shri Deepak Kumar Shri Pankaj Kumar (*Alternate*)
Centre for Science and Environment, New Delhi	Dr Sumita Singhal
Chennai Metropolitan Water Supply and Sewerage Board, Chennai	Ms N. Manimegalai Ms G. Magarajothi (*Alternate*)
CSIR - Indian Institute of Toxicology Research, Lucknow	Dr Preeti Chaturvedi Bhargava Dr Satyakam Patnaik (*Alternate*)
Delhi Jal Board, New Delhi	Shri Sanjay Sharma Shri Ashutosh Kaushik (*Alternate*)
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, New Delhi	Ms Monika Bahl Shri Rahul Sharma (*Alternate*)
Engineers India Limited, Gurugram	Shri Parveen Kumar Goel Ms Antara Das (*Alternate*)
Indian Institute of Technology Delhi, New Delhi	Prof Arun Kumar Prof V. Arya (*Alternate*)
Indian Institute of Technology Roorkee, Roorkee	Dr K. S. Hari Prasad Prof Zulfequar Ahmad (*Alternate*)
Institute of Engineers India, New Delhi	Shri J. C. Singhal
L&T-Sargent & Lundy Limited, Vadodara	Shri Karthick Belligundu Shri Akash Kumar Dineshbhai Shah (*Alternate*)
Maharashtra Jeevan Pradhikaran, Mumbai	Ms Mohua Salilkanti Banerjee Ms Pallavi P. Chougule (*Alternate*)
Military Engineer Services, Bengaluru	Shri Padmanabh Maniyar

Organization	*Representative(s)*
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Ministry of Jal Shakti, Department of Drinking Water and Sanitation, New Delhi	Shri Samir Kumar
National Environmental Engineering Research Institute (NEERI) - CSIR, Nagpur	Dr Pranav Nagarnaik Dr P. K. Labhasetwar (*Alternate*)
National Institute of Disaster Management, New Delhi	Prof Chandan Ghosh Prof Amir Ali Khan (*Alternate* I) Prof Ajinder Walia (*Alternate* II)
National Institute of Hydrology, Roorkee	Dr Mukesh Kumar Sharma Dr Rajesh Singh (*Alternate*)
Public Health Engineering Department, Kolkata	Shri Hemanta Koley Shri Soumitra Chakraborty (*Alternate*)
Quality Council of India, New Delhi	Ms Anuja Anand
Saviram Engineering Consultants Private Limited, Civil Engineering Department, Noida	Shri Girish Chandra Mishra
The Energy and Resources Institute, New Delhi	Dr Sonia Grover Ms Niyati Seth (*Alternate*)
Voluntary Organisation in Interest of Consumer Education (VOICE), New Delhi	Shri B. K. Mukhopadhyay Shri K. C. Chaudhary (*Alternate*)
Water and Power Consultancy Services Limited, Gurugram	Shri Rajat Jain
In Personal Capacity (*Flat No. 103, H.No. 3-3-108/Kr/103, SV Enclave, New Friends Colony - 2, Attapur, Hyderabad*)	Shri Rajeshwar Rao Bandari
In Personal Capacity (C/o 'A' Mess, Near Div Chow*k, Durpin Dhara, Kalimpong*)	Col A. K. Chaubey
In Personal Capacity (*House No. 7, Northex Model Town Extension, New Delhi*)	Shri R. S. Tyagi
BIS Directorate General	Shri S. K. Kanogia, Scientist 'F'/ Senior Director and Head (Service Sector) [Representing Director General (*Ex-officio*)]

Member Secretary
Kumari Priyanka Singh
Scientist 'B'/Assistant Director
(Service Sector), BIS

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